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vered in this county of such high antiquity ; and will satisfy the learned, that the Romans had penetrated into the westernmost parts of Cornwall before the empire became Christian : that the sacrificial vessels, the pateræ, and præfericulum, are of tin, the natural product of Cornwall : the vase, the weights, the millstone, are also of Cornish granite : and by the walls, the religious utensils, the weights, the quantity of shoes, bones, horns, vases, urn, and ashes, this fort appears to have been that of a fixed garrison, not a temporary occasional fortification : that by the shape of this fort, and the antiquities discovered in it, it was a Roman fort.

I remain,

S I R,

Your most obedient Servant,

William Borlase.

IV. *A new improved Silk-Reel. By the Rev. Samuel Pullein, M. A.*

Read Feb. 1, 1759. THE following paper, it is hoped, will help to promote the culture of silk in our American colonies, and to bring it to that perfection, which at present is scarce found in any country but Piedmont.

When silk is reeled from the cocoons, the thread is smeared with the natural gum of the silk softened by the heat of the water out of which it is reeled.

If

If the several rounds of this thread, as it falls on the reel, touch one another in their whole extent, it is then so glued together, as to be intirely useless for any perfection of manufacture, it being impossible to wind it off without tearing and breaking. This fault in the silk countries goes under the technical name of the Vitrage ; and there are many degrees of it, according to the cause by which it is produced.

From the introduction of silk into Europe to this day, the preventing of the Vitrage has employed some of the most knowing men in the countries where silk is produced.

To change the position of the silk thread, that it might not always fall on the same part of the reel, the guidestick was introduced. This received a progreffive and regressive motion, by means of two wheels, the one fixed to the axle of the reel, and communicating its motion to the other by means of a band. To make these wheels perfect, certain determined and precise proportions are to be oberved in the diameters of their grooves, otherways, notwithstanding the motion of the guidestick, there may be a total Vitrage of the whole hank of silk ; and, even when the proportion of the wheels is perfect, there may be reckoned up thirteen or fourteen accidents, any of which happening will cause a Vitrage : but tho' these inconveniencies attend all those reels which use a band, yet, because the ordinary sort of them are easily made, they are still used by the common people in most silk countries.

No nation has brought its silk to a greater perfection than the Piedmontese : but it was only by slow degrees, and in a long tract of time, that they arrived

ived at this. They first suppressed the old method of reeling the silk over a bobin, which was found to give it a flat form ; and they substituted in its stead that excellent method of the croiffure, which renders it round and compact. They then applied themselves to correct the imperfections of the guidestick, and to establish proper proportions between the wheels which gave it motion : but, notwithstanding these and other improvements, they still found, that, so long as these wheels were turned by means of a band, they could not arrive at the perfection necessary to make silk fit for organcine or warp, because the inaccurate motion of the band made the most just proportion which they could establish between the wheels quite ineffectual, and constantly produced a Vitrage.

It was on this account that they totally suppressed the usage of the band, and substituted in its stead four wheels with a determined number of teeth, whose revolutions, being uniform, gave the guidestick a proper motion for preventing the Vitrage. This, and some other regulations, are established by laws, which are rigorously put in execution, lest the common people should thro' indolence relapse into their old customs. By adhering to this reel, the Piedmontese are able to give that perfection to their raw silk, which fits it to be thrown into organcine or warp ; and to raise the value of each pound of silk reeled in this manner to one third more than it would have if reeled otherways.

The French were desirous of making raw silk fit for organcine or warp among themselves, which hitherto they have had from Piedmont. Whether they thought

thought the Piedmontese reel could not easily be brought into common use, or whether a little vanity hindered them from copying or improving the inventions of other nations, I will not determine. However that be, they applied themselves wholly to the improvement of the band-reel.

Two persons, *viz.* M. St. Priest of Languedoc, and M. Vaucançon of the Academy of Sciences at Paris, have, within these three or four last years, brought the band-reel to the greatest perfection of which it is capable. Either of their reels will make raw silk fit for organcine or warp, provided they are accurately made; but a small error in their construction destroys their perfection. I have now in my possession a reel made according to M. Vaucançon's method; where I can shew, that in two wheels, whose diameters differ but very inconsiderably, one shall reel the silk properly, and the other throw it into a total Vitrage. I have however given a description and plate of this reel, in a treatise on the culture of silk, which I published last year, because its contrivance is more simple than that of M. St. Priest, and performs as well.

The Piedmontese reel is free from the inconveniences of all those reels which use a band: the maker cannot easily err in the construction; the weather cannot affect its operation; nor is it subject, during its work, to the many irregularities of the band-reel. The chief objections which have hindered its being commonly used are, that four toothed wheels are more difficult to be made than two plain grooved ones; and that being made only of wood, they are easily broken. So that it is necessary to

have a double set of them, in order to prevent those delays which might happen by their breaking; because any delay in the reeling of silk occasions a considerable detriment.

Our happier constitution doth not admit such rigorous laws as that of Piedmont. To make the common people adopt any new contrivance, they must not only know that it is the best, but they must also feel that it can be easily practised. Those who superintend public filatures in our colonies may indeed, for the present, keep their workmen to the Piedmontese reel; but public filatures can no more produce large quantities of silk than public spinning-houses could produce the vast quantities of linen-yarn which are now raised from private family-wheels: And when the management of silk-worms becomes more common in our colonies, and people find that, by reeling their own cocoons, their profit will be nearly doubled, and this with much less labour than was used in rearing the worms; when this, I say, shall happen (and it is to be hoped it soon will), then the making of the Piedmontese reel more simple, and more familiar to the common people, will I believe appear a thing of considerable importance to our silk manufactures.

I some time ago turned my thoughts to the effecting of this; and should before now have put them in execution, had I not distrusted my own abilities to perform a thing, which the Piedmontese themselves had not attempted. I have now constructed a reel, which, without any additional mechanism, performs the work of the Piedmontese reel, and uses but two wheels with teeth instead of four wheels. It has

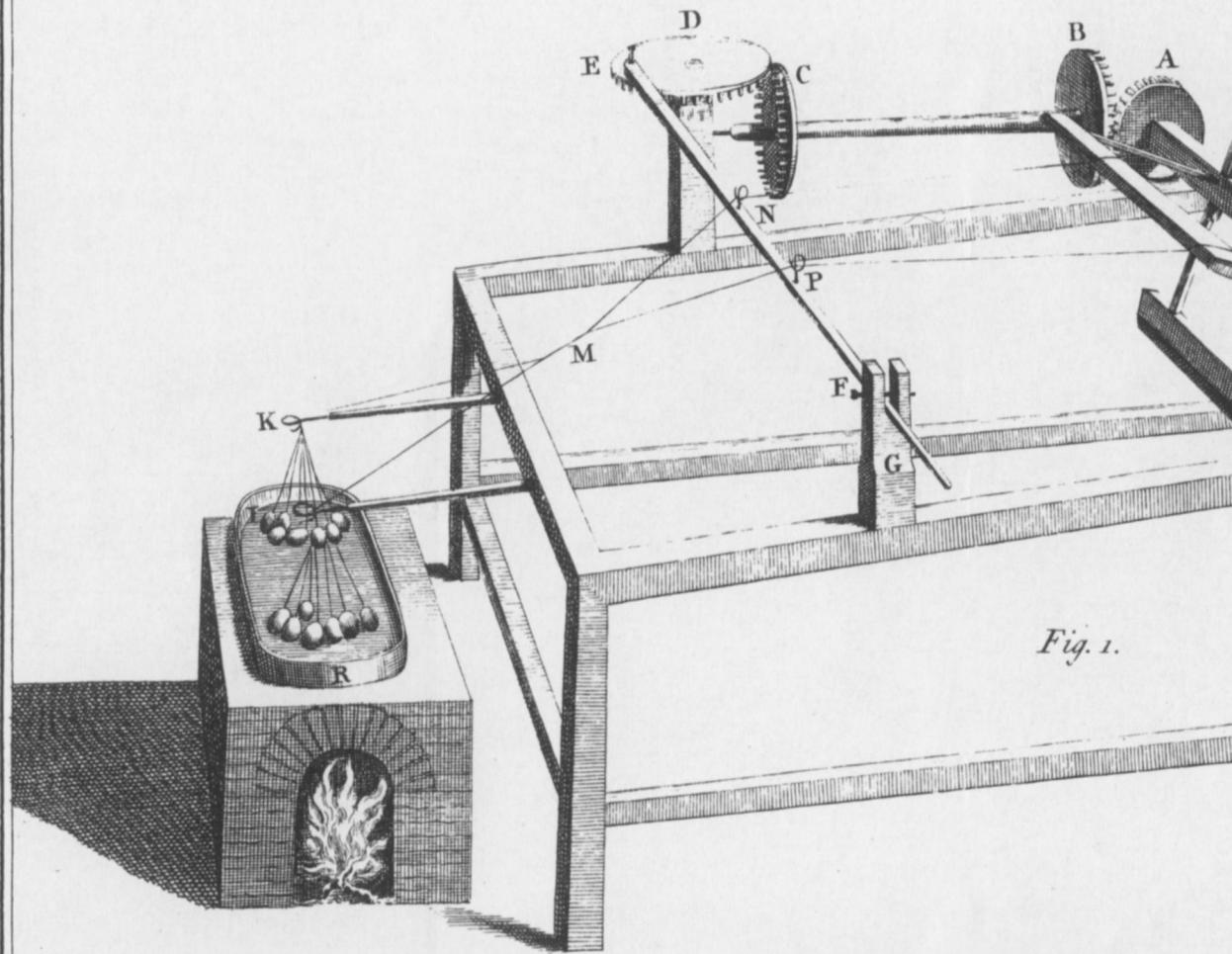
been examined by some gentlemen in the silk-trade, who are well acquainted with the reels of that country, and allowed to work with much more simplicity, and greater perfection. Nor can I account why this improvement was not before attempted, but from the strong bias of habit confining the powers of invention.

Some advantages, which this reel seems to have above the present Piedmontese reel, are, 1st, that by a new proportion struck between the wheels, the silk thread will not be laid in the same place on the reel till after the winding of near six hundred yards: by which means, the thread having time to dry, all Vitrage is avoided; whereas those now used do not reel above an hundred and fifty yards till the thread is laid in the same place.

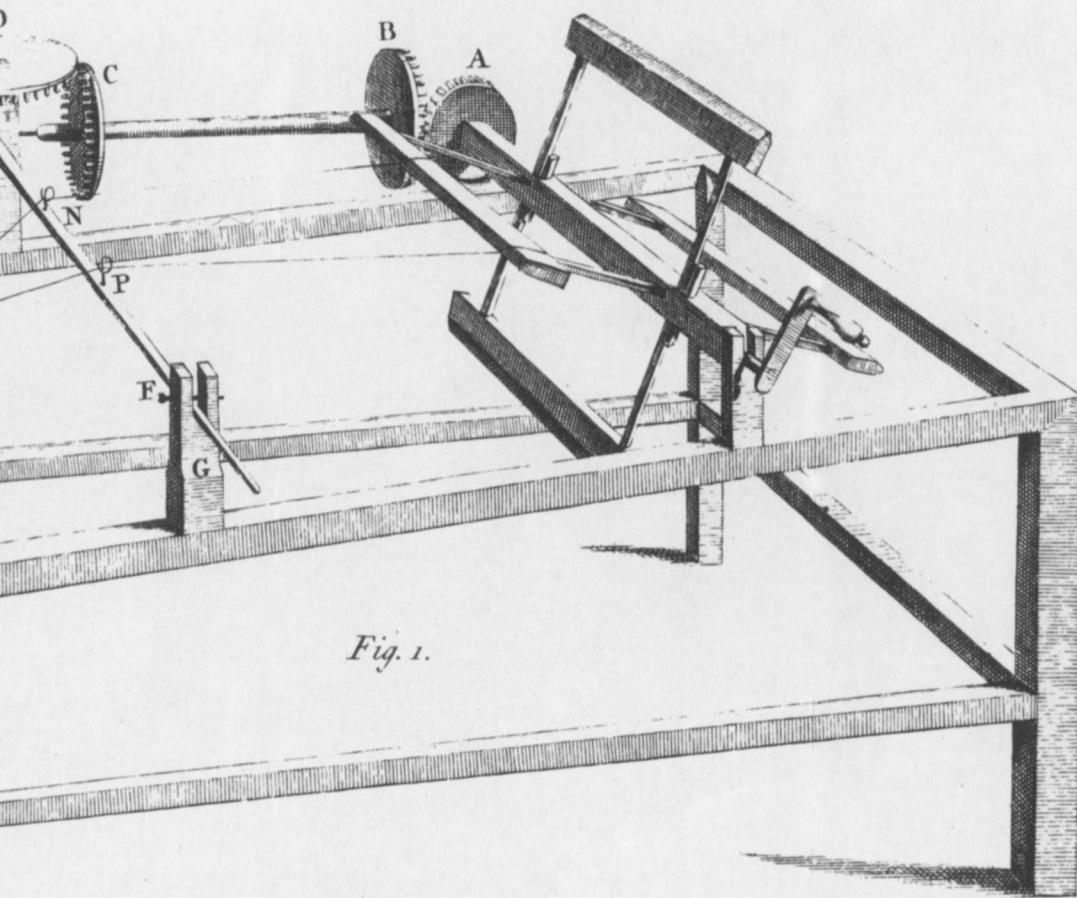
2dly, I have added to this reel an improved method of making the double croiffure in as easy a manner as the Piedmontese now make the single one; the double croiffure giving a considerable perfection to the silk above what it obtains from the single one.

As the limits to which I purpose confining this inmemoir will not allow of a more extended description, which, to gentlemen not versed in these matters, may already be thought too long, I shall avoid a greater trespass on your attention, by a brief reference to the annexed figure [*See TAB. II.*], and to the model before you [*See TAB. III.*].

*TAB. II.* represents the present Piedmontese reel. The position of the four wheels is shewn at A, B, C, and D: the toothed wheel A is fixed upon the axle



*Fig. 1.*



*Fig. 1.*

of the reel ; and, as the reel turns, it gives motion to the two wheels B and C, which are fixed upon one common arbre. The wheel C moves the wheel D, which is placed horizontal ; and this, as it revolves, makes the guidestick E F play forward and backward in a groove made in the upright G, the guidestick playing freely on a pin E fixed in this wheel. Two threads of silk, drawn from two parcels of cocoons, which lie in the copper of hot water R, are passed thro' the two loops of the stop-wires K and L : they then are twisted round each other at M, which is the single croissure of the Piedmontese. At M they are again separated, and pass each through its own guide-wire at N and P ; and from these they go to the reel, where, as the reel turns, the motion of the guidestick continually varies their position, and hinders them to be laid on the same place.

The model before you, represented by *Tab. III.* exhibits the new construction which I have given to this reel. The two wheels C and D of *Tab. II.* are laid aside as superfluous : the arbre Q passes thro' a nich in an upright supporter R, and, by a winch at its end A, gives motion to the guidestick. The plane of its motion in the Piedmontese reel is horizontal, but here it is perpendicular. This perhaps made them think that the effect would not be the same : but it doth not cause any essential difference ; and if it had, there was a most easy remedy for it.

Here therefore the expence and trouble of making and adjusting two wheels and two sets of teeth are saved, the hazard of breaking and going out of order lessened, and the machine made more simple, and more familiar to the understanding.

As I intend, at a convenient time, to give a more ample account of the method in which silk is reeled, and of the various attempts which have been made to improve the silk-reel, together with their success, that persons may not waste their time upon fruitless experiments ; and having hopes also that I shall be able to add some further improvements to it, of which I have not as yet had leisure to make trial ; for these reasons I shall for the present take leave of this subject, at least with this pleasing thought, that the pains I have taken may possibly hereafter promote the industry and profit of such poor families as are, in all countries, the supporters of the silk manufacture.

Samuel Pullein.

In *Tab. III. fig. 1.* at A is shewn the manner in which I have made a winch D, fixed in the arbre Q A, answer the same purpose as the two wheels with teeth, which are used in the Piedmontese reel ; by which the mechanism is rendered more simple, and the guidestick F moved to the same advantage as with the wheels.

At *fig. 2.* is shewn the double croiffure, made by means of the cross B, which I shall call a swivel-cross. It is made of very slight scantling, such as a common lath may afford. At b b are fixed two little ivory or brass wheels with smooth acute-angled grooves in them to receive the threads which come from the two stop-wires b b. One end of the swivel-cross K is somewhat broad, and rests upon the guidestick F directly in the middle between the two guide-wires c c. Here it moves and plays freely

on

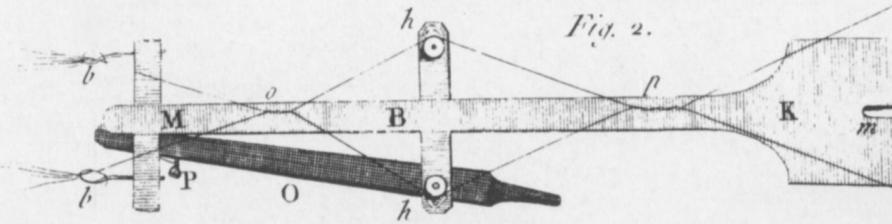


Fig. 2.

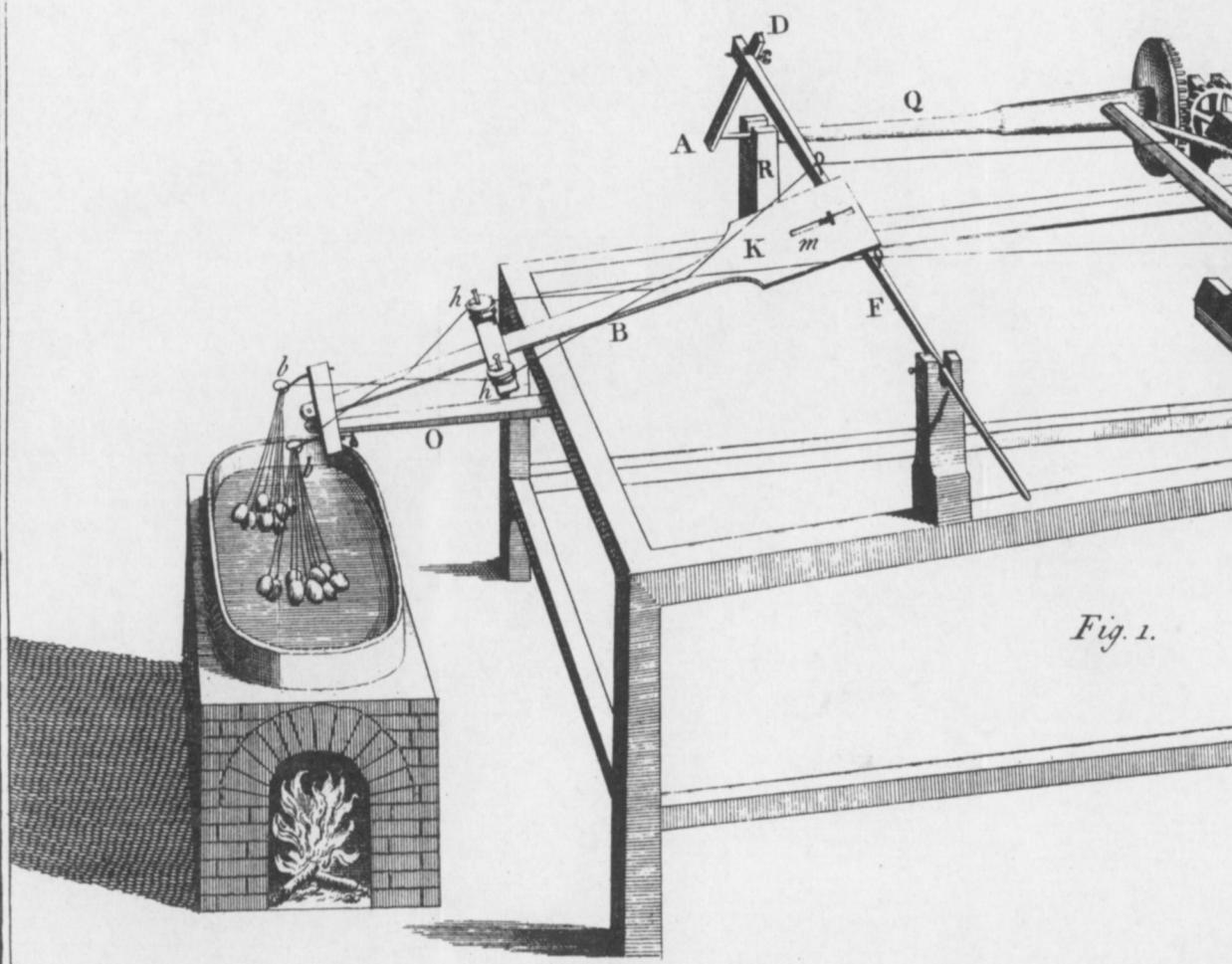
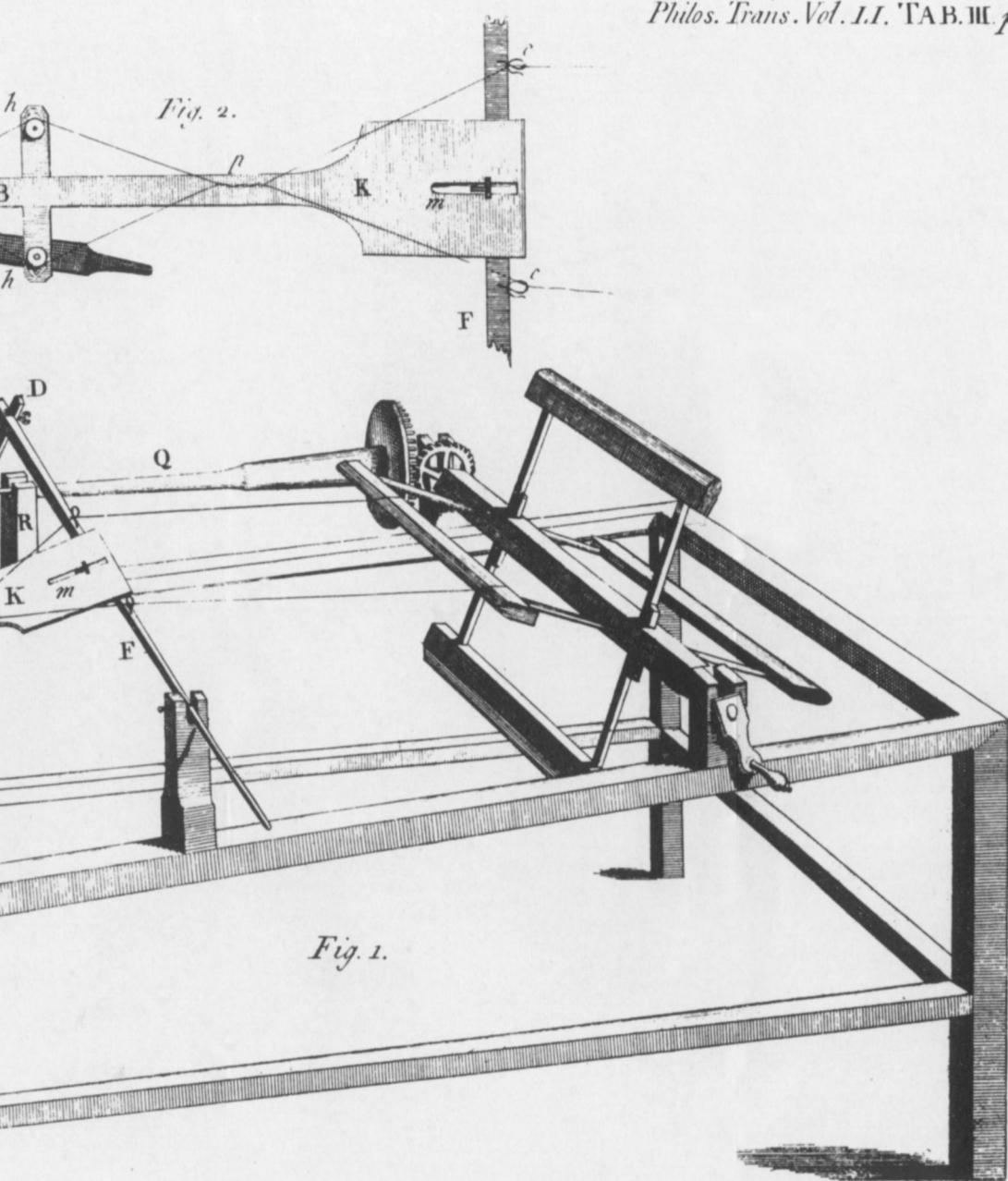


Fig. 1.



on a pin fixed in the guidestick, the pin passing thro' the nich>m. The other end of the swivel M contains the stop-wires *b b*, and is attached to the end of the rod O, which projects from the front bench of the reel. This attachment is made by means of a piece of packthread with a knot on its end ; which pack-thread passes thro' a hole in the swivel and in the piece O, and being fixed to a peg P, which turns in the under part of the piece O, is drawn to a proper degree of tension to allow the swivel to obey all the motions of the guidestick.

The manner of making the double croiffure is thus : The two silk threads are passed thro' the two stop-wires *b b*, and thro' the two guide-wires *c c*, and so are fastened to the reel. Then either of the two threads is taken in that part of it which lies between the stop-wire and guide-wire, and turned two or three times round the other thread ; and then each thread is placed in the groove of the pulley at *bb*, taking care to place each in the groove of that pulley which lies on the side of its own stop-wire. The threads will then appear in the situation represented in the figure twisted round one another in the two points *o* and *p*.

The great advantage of this method is the taking off the pressure of the threads, by making them pass over two pulleys instead of two hooks ; and by the swivel complying with all the motions of the guidestick, which keeps the angles of the croiffure constantly the same : without this, the bearing of the threads and the variation of the angles will make them so liable to break, that, from many experiments which I have made, I might venture to say, that

that tho' the double croiffure has many advantages in compacting the silk thread, and shaking off its moisture, yet without such contrivance it will scarce ever be put in practice. I must also take notice, that this contrivance is vastly more simple than that which Mons. Vaucançon uses, tho' his has no one of these advantages. A description of his method may be seen in the treatise which I lately published on the culture of silk, for the use of our American colonies, sold by Mr. Millar in the Strand; but I had not at that time thought of these improvements.

N. B. In *Tab. III. fig. 2.* the swivel-cross is represented somewhat large, and separate from the reel, the better to distinguish its parts; but at *B, fig. 1.* it is shewn in its true proportion and situation when the reel is ready to work.

*V. Experiments on several Pieces of Marble stained by Mr. Robert Chambers. In a Letter to the Rev. Thomas Birch, D. D. Secret. R. S. from Mr. Emanuel Mendez da Costa. F. R. S.*

Rev. Sir,

Read Feb. 8, 1759. I Take the liberty to address to you some notices on the art of staining or painting of marble, and the experiments I made on those pieces of painted marble produced before this Society, at their meetings on the 21st December and 11th January last. The